R E P O R T R E S U M E S

ED 017 013 CG 001 676

THE AFFECTIVE COMPONENTS OF PRODUCTIVE THINKING, STRATEGIES OF RESEARCH AND ASSESSMENT.

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PUB DATE FEB 68

EDRS PRICE MF-$0.25 HC-$0.52 11P.

DESCRIPTORS- *PROBLEM SOLVING, *EMOTIONAL EXPERIENCE, *RESEARCH DESIGN, INTELLECTUAL EXPERIENCE, *COGNITIVE PROCESSES, COGNITIVE TESTS, *TEST CONSTRUCTION, SELF EVALUATION,

NEW DIRECTIONS FOR RESEARCH MAY MORE CLEARLY REVEAL THE NATURE OF THE RELATIONSHIP BETWEEN AFFECTIVE VARIABLES AND INTELLECTUAL PERFORMANCE. ONE AFFECTIVE COMPONENT SHOULD NOT BE SINGLED OUT FOR MEASUREMENT. RATHER, A PATTERN OF DISPOSITIONS SHOULD BE DETERMINED AS A UNIT OF PREDICTION OF EFFECTIVE PERFORMANCE. VARIOUS COPING STYLES SHOULD BE FRACTIONATED INTO MORE DISCRETE AND IDENTIFIABLE MENTAL OPERATIONS CARRIED OUT BY THE INDIVIDUAL. THE STUDENT'S ABILITY TO EFFECTIVELY COORDINATE AND DEPLOY THE DIVERSE COGNITIVE STRATEGIES ASSOCIATED WITH VARIOUS COPING STYLES CAN THEN BE TESTED. TESTS WHICH REFLECT SUCH A "MANAGERIAL" CAPACITY ARE DESCRIBED. OVERSIMPLIFICATION CAN ALSO BE AVOIDED BY VARYING THE KINDS OF OUTPUT MEASURES USED. DATA ON TESTS DEVELOPED TO TAP VARIOUS FACETS OF THE PROBLEM-SOLVING ACT ARE PRESENTED AS PROOF THAT ATTITUDINAL VARIABLES ARE RELATED TO PERFORMANCE IN A COMPLEX MANNER DEPENDING, IN PART, ON THE KIND OF OUTPUT MEASURES EMPLOYED. DESCRIBED ARE ATTITUDES TOWARD THE SELF AS A PROBLEM-SOLVER WHICH MAY INFLUENCE THE ACT OF PROBLEM-SOLVING. AN ASSESSMENT DEVICE EXPLORES THE RELATIONSHIPS BETWEEN THE PROBLEM-SOLVING ACT AND SELF-APPRAISAL OF WORTH AS AN EFFECTIVE THINKER. THIS SPEECH WAS PRESENTED AT THE AMERICAN EDUCATIONAL RESEARCH ASSOCIATION CONVENTION, CHICAGO, ILLINOIS, FEBRUARY, 1968. (PS)

ED017013

THE AFFECTIVE COMPONENTS OF PRODUCTIVE THINKING: STRATEGIES OF RESEARCH AND ASSESSMENT[1,2]

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Over the last few years, several colleagues and I have been engaged in the development of a series of instructional programs for elementary school children with the aim of fostering the psychological processes which underlie productive thinking and in particular, complex problem solving. To date the main focus has been on strengthening various intellectual skills and strategies with a secondary emphasis on the affective components of productive thinking--the attitudes, values, beliefs and coping styles--which favor complex mental functioning. The purpose of this paper is to enlarge upon the conceptual framework within which we are presently working: to consider some of the ways in which attitudes, beliefs and affective processes in general enter into the act of productive thinking with the ultimate intention of manipulating such processes by instructional means so as to facilitate the student's overall level of effective thought.

To begin with, we assume that creative or productive thinking is not a personality dimension in the general sense used by many previous investigators. Instead such thinking is viewed as a complex set of behaviors; actually a series of intellectual acts, such as idea-generation and question-asking which occur in an ordered sequence, forming a complete thought episode. Moreover, we assume that it is the role of affective-type variables to

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1. The research reported in this paper is supported by a grant from the Carnegie Corporation of New York, under the direction of the author and Dr. Richard S. Crutchfield.

2. Invited paper read at symposium: Definitions of Problem Solving as Goals for the Elementary School. American Educational Research Association Convention, Chicago, February, 1968.

structure, organize and sustain these intellectual operations. For example, the structure of a thought episode will differ markedly for two individuals, one who approaches difficult thought problems in an impulsive manner with little taste for persistence, and the other disposed to a more reflective style. Additionally, there is accumulating evidence from several sources, including our own laboratory, indicating that the possession of such coping styles along with relevant attitudes and beliefs are correlated only negligibly with general intellectual capacity.

The problem now is how to proceed on the basis of these plausible sounding, but as yet rather vague formulations in order to specify what particular kinds of affective factors to strengthen, in what combinations, and by what means. One approach--an admittedly empirical, eclectic one--is to begin by searching for evidence of possible regularities existing between various affective variables and actual problem-solving performance. If such a relationship can be demonstrated, say, between the extent of the student's understanding of and beliefs about the process of thinking and the likelihood of his achieving a solution to a difficult thought problem, then one can take steps to determine if some type of causal mechanism is operating, that is, whether fostering more positive beliefs about thinking by appropriate instructional techniques will make for a corresponding improvement in the student's actual performance. Unfortunately, despite the obvious virtues of this approach--its directness and primary reliance on empirical findings--it is not very helpful in actual fact simply because there is surprisingly little evidence that affective variables are systematically related to any aspect of actual problem-solving performance.

Thus, the main purpose of this paper, having undergone a degree of refinement from the necessarily more global introduction, is to suggest new directions for research which have some likelihood of revealing, with greater clarity, the actual nature of the relationship between affective variables and performance. This will involve the offering of concrete suggestions as to specific lines of investigation to pursue as well as an indication of some new, heretofore unexplored kinds of assessment techniques which might prove useful.

Perhaps one of the main reasons for the general lack of positive findings is that much previous research reflects an overly simplified view of how affective processes enter into the problem-solving act. For example, implicit in one of the most popular forms of research in this area is the assumption that if some particular affective coping style, such as tolerance for ambiguity, is a necessary condition for solving a particular problem, then scores on a test reflecting tolerance for ambiguity should be correlated with the quality of the student's actual performance. Quite apart from the issue of whether or not the test really measures the purported construct, this kind of reasoning implies that the affective variable exerts a direct and linear influence on performance, unadulterated by other factors which enter contemporaneously into the problem-solving act. This runs counter to the view that a number of coping styles, many of them antagonistic to one another, interact in the course of a problem-solving episode. Specifically, if a general set toward a tolerance for ambiguity is not balanced by an opposing disposition toward cognitive closure, then the individual may not, in an effective manner, take the decisive steps needed for achieving a actual solution or at least attaining a temporary reduction in complexity.

Thus, more properly conceived, one should look for a pattern of dispositions as a unit of prediction in which the optimal condition for effective performance, at least in this example, might be a configuration of both high tolerance for ambiguity and high need for closure.

Furthermore, we can envision more sophisticated, and perhaps more revealing, assessment techniques which go beyond simply establishing the existence of such dispositions and their relative strengths, to reveal something of the processes of managing and deploying such antagonistic factors during the actual course of problem solving. This requires the fractionation of the various coping styles--which traditionally have been treated as rather vague, diffused sets or inclinations--into more discrete and identifiable mental operations which are carried out by the individual. For example, a disposition toward reflectivity is, no doubt, embodied in a number of specific mental acts such as reviewing all the facts before making a decision, asking for further clarifying information, or generating rhetorical questions. At this level of analysis, we are asking if the student can effectively coordinate and deploy the welter of diverse cognitive strategies associated with various coping styles.

Presently under development in our laboratory are tests designed specifically to reflect such a "managerial" capacity. The student is given a complex problem to solve which is presented in a test booklet with a programmed instructional format. At various points in the problem-solving sequence the student is required to indicate what course of action he would next pursue, given the development of the problem to that point. Each item is presented in a multiple-choice format with several alternatives,

each varying in the degree of appropriateness. Thus, by using such a sequential technique, one can appraise the student's sense of timeliness and planfulness in the context of an ongoing problem episode. In light of some promising preliminary findings, we have hopes that this assessment technique may shed light on the operation of affective coping styles as they affect the course and quality of the problem-solving act.

We turn next to a second source of oversimplification regarding previous research. A typical approach is to establish correlations between each of a number of affective-type variables but with only one output measure, usually an overall estimate of the quality of the student's performance. Yet there is reason to believe that affective variables are related to performance in varying degrees, depending on the kinds of output measures used. Data on this point have been collected in our laboratory. Ninety-one fifth-grade students were administered several problem-solving tests along with measures of various attitude-type variables. The problem-solving tests were representative of a number of paper-pencil, group-administered instruments, developed by our staff to assess problem-solving proficiency among upper elementary school children. These tests, which are also cast in a programmed format of the type described above, tap a number of facets of the problem-solving act, including the generation of ideas, checking these ideas against the facts, restructuring the problem in its simplest form and listing questions thought to be important in achieving a solution. Because of the scope and complexity of these tests, several performance measures of ideational output can be obtained for each student, including: (1) total number of ideas generated, irrespective of their quality, (2) total rated quality of these ideas, (3) quality rating of the best single idea, regardless

of how many ideas the student produced, and finally (4) whether a classic solution occurred or not.

As to the attitudinal variables employed, three are reported here: (1) a measure of the student's beliefs about the thinking process; (2) a measure of the pupil's estimate of his own ability to deal successfully with difficult thought problems; and (3) the Test Anxiety Scale for Children. Table 1 presents the Pearson Product-Moment Correlations between each of these variables and the four performance indices. In all cases, the figures are first-order partial correlations with IQ held constant. Briefly, the patterns of correlations are quite different for each of the attitudinal variables. For Scale 1, concerning the student's beliefs, there is an increase in the magnitude of the correlations in a positive direction as the performance indices increase in complexity (reading down Column 1), whereas the direction of this relationship is exactly reversed for anxiety level, with a rank-order increase in the magnitude of the correlations in the negative direction. In the case of Scale 2, which reflects the student's self-evaluation, there are only negligible correlations with each of the performance measures. Apart from speculation about why these various patterns arise and whether the information might prove useful in the development of instructional techniques to foster productive thinking, there is the overall conclusion to be drawn that attitudinal variables are related to performance in a complex manner, probably depending in part on the kind of output measures employed. Furhter research along these lines, using appraisal instruments capable of reflecting a number of facets of performance, may prove quite helpful in increasing our understanding of the nature of the contribution of attitudinal factors to problem-solving proficiency.

A third and final point arises from the data just presented and is included here simply as a further example of the kinds of rethinking which may be necessary in this area of research. It concerns the lack of relationship between the various performance indices and the individual's self-appraisal as an effective problem-solver--a finding which is consistent with previous research. In light of this empirical state of affairs, it is suggested that we look for other ways in which one's attitudes toward himself as a problem-solver might be influential in the problem-solving act, besides affecting directly the quality of his performance. One likely possibility is that the adequacy of one's self-concept is related to the degree to which the individual is willing to engage in productive thinking.

In order to explore this possibility, we are now developing a series of tests to establish the student's preferences for engaging in various tasks, differing in the degree to which they require productive thought for their solution. Each of these tasks actually represents various sub-tasks within the context of the same general problem, thus holding reasonably constant the student's level of intrinsic interest in the problem itself. In a typical case the student is given the choice of either dealing directly with the problem, which usually means trying to make sense out of some puzzling data, or of engaging in a routine clerical job which, although related to the problem, requires a modicum of productive thought. Additionally, the student is required to work on the task he chooses, at least briefly, rather than to stop with a simple statement of preference. This type of assessment device may prove useful in exploring the relationships which doubtless exist between the problem-solving act and one's appraisal of his worth as an effective thinker.

In summary, a good deal more basic research is needed regarding the manner in which affective factors enter into the productive thinking act, especially before we can make informed pedagogical decisions about the kind of instructional sequences needed to facilitate the student's level of productive thinking performance. The kinds of research strategies employed and assessment techniques developed will inevitably determine in large part our definition of problem-solving as one of the basic goals of the elementary school.

The Affective Components of Productive Thinking:

Strategies of Research and Assessment[1,2]

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Table 1

Correlations Between Selected Attitude Measures

and Four Indices of Ideational Output

	Scale I (Beliefs)	Scale II (Self-evaluation)	Test Anxiety Scale
Total Ideas Composite	-.39**	-.08	+.21*
Total Quality of Ideas Composite	+.09	+.12	-.05
Single Highest Rated Idea Composite	+.36**	+.14	-.15
Total Number of Solutions Composite	+.40**	+.09	-18*

*Significant from zero at .05 level

**Significant from zero at .01 level

[1] The research reported in this paper is supported by a grant from the Carnegie Corporation of New York, under the direction of the author and Dr. Richard S. Crutchfield.

[2] Invited paper read at symposium: Definitions of Problem Solving as Goals for the Elementary School. American Educational Research Association Convention, Chicago, February, 1968.

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